re-sourcing

Mobility Sector

Civil Society

Roadmap for Responsible Sourcing of Raw Materials until 2050

**Stefanie Degreif, Dr. Johannes Betz,
Hannah Bachmann,
Öko-Institut e.V.**

August 2023

Disclaimer:

Imprint:

Acknowledgements:

Contents

Figures

Abbreviations

ASM	Artisanal and small-scale mining
BEV	Battery electric vehicle
CSOs	Civil Society Organisations
DRC	Democratic Republic of Congo
EC	European Commission
EU	European Union
EU27	27 Member States of the European Union
G7	Group of Seven (Canada, France, Germany, Italy, Japan, United Kingdom, United States)
GHG	Greenhouse gas
ICE(V)	Internal combustion engine (vehicle)
IFC	International Finance Cooperation
LCA	Life cycle assessment
LIB	Lithium-ion batteries
NGO	Non-governmental Organisation
OECD	Organisation for Economic Co-operation and Development
OEM	Original equipment manufacturer
RS	Responsible Sourcing
SDGs	Sustainable Development Goals
SLO	Social licence to operate
SME	Small and medium-sized enterprise

Executive Summary

The transformation of the mobility sector is essential in order to meet the Paris Agreement's goals. A 90% reduction in transport-related emissions by 2050 is needed to achieve climate neutrality. To achieve this, a major contribution will come from new technologies: the battery electric vehicle technology is the most promising technology today. The roadmap for the mobility sector therefore focuses on lithium-ion batteries (LIBs). While the global market for this technology is growing rapidly, production and end-of-life are linked to major environmental and social impact concerns. To ensure a just transition, it is crucial to implement high social and environmental standards in production and sourcing along the entire supply chain including end-of-life.

Following the State of Play and Roadmap Concepts for the Mobility Sector – a stock-taking report of the current sustainability challenges in the mobility sector – this report by the RE-SOURCING project focuses on the road towards achieving a sustainable mobility transition by 2050. The roadmap addresses four relevant raw materials used in LIBs (lithium, cobalt, nickel and graphite) and three supply chain stages (mining, cell manufacturing and OEMs, and recycling). Recommendations for EU policy makers, international industry (cell and battery producers, OEMs, recyclers, etc.) and Civil Society Organisations (CSOs) were developed to achieve the identified three main targets needed for a sustainable mobility sector (see figure below):

- **Circular Economy & Decreased Resource Consumption**
- **Responsible Procurement**
- **Level Playing Field**

For the development of the Roadmap, the RE-SOURCING project relies primarily on bringing together existing knowledge from key stakeholder groups and regions. A series of six webinars during October 2021 and June 2022, supplemented by additional expert consultations, were used to elaborate the recommendations presented in this report. It is obvious, that **we need to act now** without any further delay to ensure changes in these long-lasting processes of a life cycle of a mine, production facilities and recycling strategies. This is why there is a very high number of recommendations up to 2030. These actions are the basis for achieving milestones for 2040 and 2050.

The key issues for all three targets are **communication** between all stakeholder groups and along the whole value chain as well as **transparency** to provide the basis for changes. In addition, the **rethinking of transport** in general as well as **thinking about the end of a material or production from the very start** (e.g., design for recycling) are essential for a sustainable mobility sector.

In this document, the recommendations for CSOs are presented, with corresponding milestones and required actions for short- (2025), medium- (2030 and 2040) and long-term (2050) time frames. The numbering of the targets does not imply any priority. All three targets are interlinked and must be pursued simultaneously to achieve the vision developed in the State of Play report for the mobility sector.

Target 1 'Circular Economy & Decreased Resource Consumption' addresses the need for changes in behaviour and the economic system to stay within planetary boundaries. A transition to a mobility sector without direct CO_2 emissions will not be possible or not be enough to mitigate all negative impacts from the mobility sector without improvements in energy efficiency and decreased demand. Additionally, end-of-life LIBs need to be seen as a strategic source of raw materials, with improved collection and recycling systems.

Milestones and recommendations in **Target 2 'Responsible Procurement'** focus more on the organisations themselves, considering the entire supply chain. Recommendations include transparency as a prerequisite for supply chain due diligence, support for sustainable development, the fair distribution of benefits and burdens, stakeholder engagement, and finding a European and worldwide common understanding of a sustainable product.

Finally, **Target 3 'Level Playing Field'** aims at harmonising requirements for companies operating and trading across the value chain in and with the EU. Raw materials or products that are produced with lower standards should be disadvantaged in the future or no longer allowed. However, creating a level playing field also implies supporting companies, regions and countries in improving their practices and achieving the required standards.
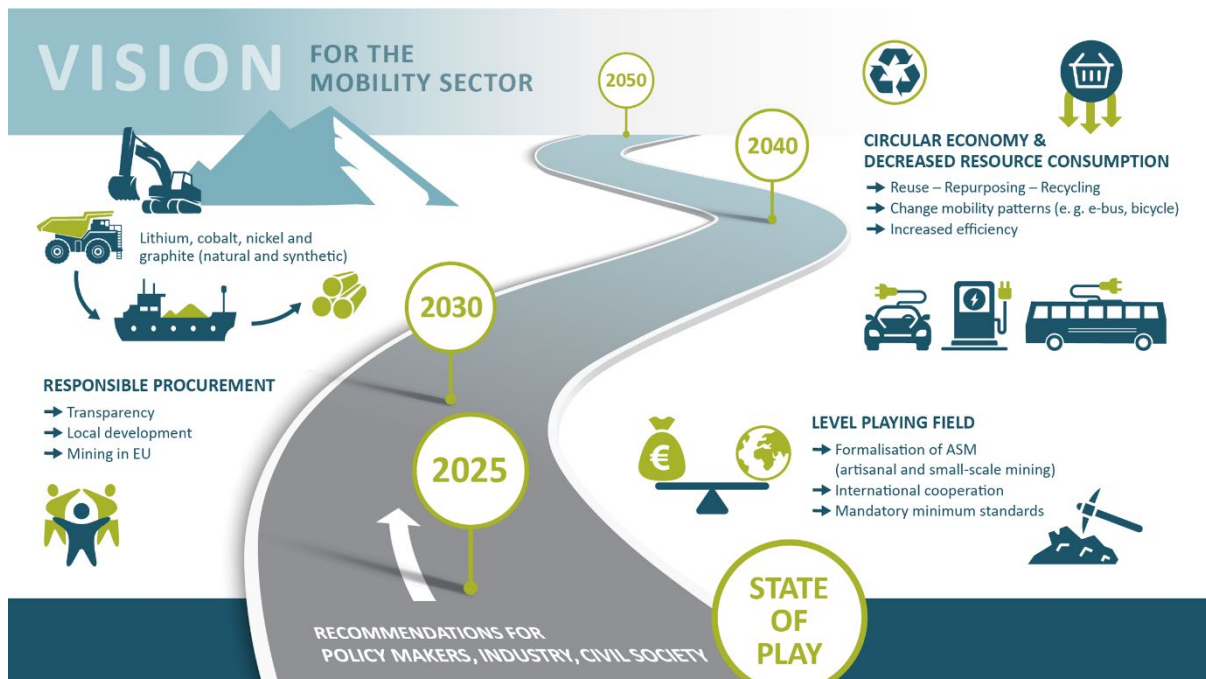
Figure: Roadmap for the mobility sector up to 2050

Keywords:

Mobility Sector, Lithium-Ion Batteries, Responsible Sourcing, Sustainability, Circular Economy

1 Introduction

1.1 The Mobility Sector

Work on the mobility sector started with the State of Play report which was published in April 2021. The aim of this report was to investigate the current state of the mobility sector with the focus on the lithium-ion battery (LIB) as the key component of electric vehicles. (Betz et al. 2021)

The mobility sector plays an important role in worldwide efforts to achieve the goals of the Paris Agreement. The legally binding international treaty on climate change was adopted in 2015 and entered into force in 2016. Its goal is to 'strengthen the global response to the threat of climate change' (Art. 2), among others by limiting the increase in the global average temperature to well below 2 °C, preferably below 1.5 °C, compared to pre-industrial levels. In order to achieve the temperature goal, 'Parties aim to reach global peaking of greenhouse gas emissions as soon as possible' (Art. 4). (UNFCC 2015)

In December 2019 the European Commission (EC) presented the European Green Deal with the aim of making 'Europe the first climate-neutral continent by 2050' (European Commission 12/11/2019). The European Green Deal requires a 90% reduction of emissions from transport by 2050 to achieve climate neutrality. However, this must be achieved without creating negative impacts in other environmental fields. To reach these targets, the EC proposes a 55% reduction of emissions from passenger cars by 2030 and emission-free new cars by 2035 (European Commission 2022).

In 2019, the mobility sector accounted for 31% of total EU greenhouse gas (GHG) emissions, as can be seen in Figure 1 below. Road transportation is of highest relevance, with more than 70% of the GHG emissions from this transportation sector (aviation, navigation and railways play a minor role).
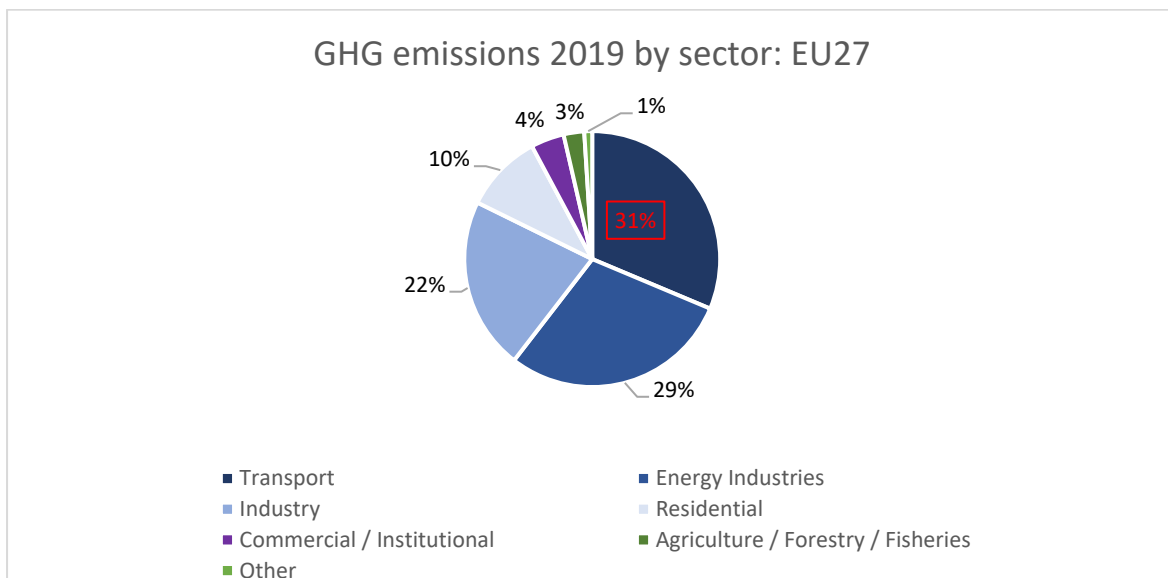
Figure 1: Greenhouse gas emissions 2019 by sector in the European Union (EU27) (data source: European Commission 2021)

This project focuses on road transportation due to its significant contribution to overall GHG emissions. The project's focus on the mobility sector value chain therefore concentrates on a future technology in road transportation – electric vehicles – as this is seen as key for a transition to

transportation with lower GHG emissions. In 2050, it is predicted that 80% of all newly registered passenger vehicles worldwide could be equipped with alternative drive systems (Oeko-Institut 2019). Figure 2 shows the significantly lower GHG emissions of battery electric vehicles (BEVs) compared to internal combustion engine vehicles (ICE(V)s), even in countries with a high share of coal-based electricity.
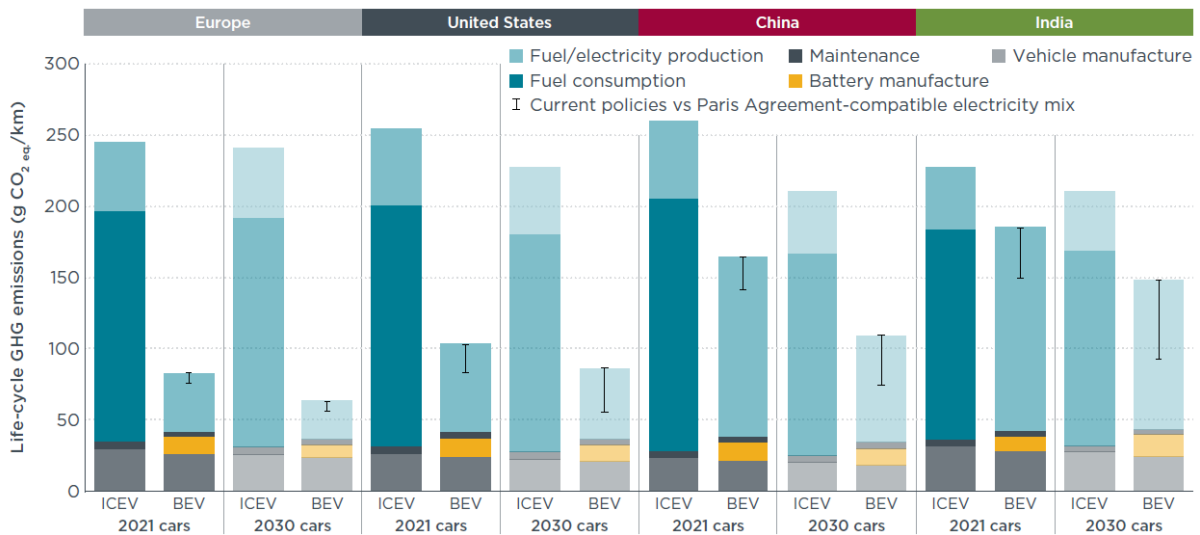
Figure 2: Life-cycle GHG emissions of average medium-size gasoline ICEVs and BEVs (Bieker 2021)

As a result, batteries are currently the main source of propulsion for cars to help achieve the Paris climate targets. The supply chain stages that are assessed in more detail in this roadmap are mining of the relevant minerals and the manufacturing of battery cells and their recycling.

In addition to the issues focussing on individual steps, there are also several overarching steps towards further minimising the carbon footprint of BEVs. Fewer and smaller cars on the roads reduce the energy and material consumption. Another important factor is increasing the share of renewable energy used for all steps in the entire value chain of a LIB. Life cycle assessments (LCA) and GHG accounting and reporting systems help to identify where emissions and energy use can be reduced. However, strong standards[1] and effective regulations for recycling are also important to reduce resource consumption and thus GHG emissions. The aim should be to achieve net zero GHG emissions.

The following paragraphs provide a brief overview of the main challenges presented in the State of Play report. For details see: State of Play and roadmap concepts: Mobility Sector. (Betz at al 2021)

Mining faces a wide range of challenges that are raw material- and site-specific. Overarching challenges in hard rock or ore mining (for the selected materials lithium, cobalt, nickel and graphite) include heavy metal pollution, acid mine drainage, energy intensive processing, habitat fragmentation, disturbance of land areas and dust pollution. For lithium from brines, water scarcity and associated social tensions as well as dust emissions are major challenges. Social dimensions related to cobalt mining are an additional issue already in the public debate. The main cobalt-producing country, the Democratic Republic of Congo (DRC), has a relatively high share (10-20% of production from DRC) of artisanal and small-scale mining (ASM). ASM is the income basis of thousands

---

[1] See explanation and criteria on a strong standard in Degreif et al. 2022

of families in the DRC. But the often informal ASM sector is connected to child labour, forced labour, inadequate health and safety conditions and funding of armed conflicts.

Battery cell manufacturing is a very energy-intensive process and associated with high GHG emissions. The toxic substances in the battery cell also require proper handling. Additionally, high susceptibility to production errors for battery cells leads to high scrap rates in production. Resource efficiency is a relevant lever to reduce the negative impacts in primary extraction. There is a need for the decoupling of economic growth from resource consumption, especially when considering the rapidly increasing demand for raw materials in the growing market of electric vehicles.

At the end-of-life (EoL) of LIBs, **recycling** is indispensable because of the high risk of 'thermal runaway' from overheating batteries leading to fires. Adequate collection, storage, transport and treatment of used LIBs are therefore essential.

This project also analysed various regulations, standards, initiatives and guidelines promoting sustainable practices in the mining sector. The availability of standards and frameworks for the battery cell manufacturing and recycling steps are rather limited while other value chain steps are covered by numerous initiatives. A gap analysis was conducted to assess whether the standards and initiatives cover the challenges that exist in the supply chains. In the mining sector, one gap identified is the large number of guidelines that often lead to confusion when it comes to compliance. An international framework that provides mutual recognition of standards is, therefore, very important. Such a framework should define terms and provide guidance for companies on which standards to apply. For customers, knowing which standards and corporate qualities are relevant is also challenging. These issues in identifying best standards are also applicable to battery cell manufacturing and the collection and recycling of EoL LIBs. There are no international guidelines addressing the whole supply chain. The proposal for an EU Regulation on (waste) batteries could offer an important step to integrating crucial elements of the supply chain in a regulation (supply chain due diligence, product carbon footprint, material specific recycling targets, recycled content, etc.).

1.2 Vision

The horizon considered for the roadmap of the RE-SOURCING project is 2050. The vision for the mobility sector (Figure 3) was developed based on the underlying concepts of the Paris Agreement[2], planetary boundaries[3] and strong sustainability[4] and will be incorporated in the definition of responsible sourcing that is developed towards the end of the project. Further information on the RE-SOURCING project's vision for the mobility sector can be found in the [State of Play report of the mobility sector](#).

The remainder of this report outlines three key target areas for achieving the RE-SOURCING Vision 2050 (Mobility Sector):

- Circular Economy & Decreased Resource Consumption
- Responsible Procurement
- Level Playing Field

The discussion of each area considers targets and milestones, followed by specific recommendations for three key stakeholder groups: policy makers, industry and civil society. This document only includes recommendations for civil society (for the other stakeholder groups see [here](#)).

---

[2] For further information on the Paris Agreement, please refer to the [UNFCCC](#) and the [legislation](#).

[3] For further information on planetary boundaries, please refer to Rockström et al. 2009 and Steffen et al. 2015.

[4] An explanation of the strong sustainability concept is provided by Ekins et al. 2003 and Dedeurwaerdere 2014.

Vision of the Mobility Sector

| Environmental | Social | Economic |

International Cooperation

Harmonised reporting systems; clear global criteria for responsible and sustainable practice

Targets across all value chain steps

Environmental
- **Limiting Climate change to 1.5 °C**
- Carbon-neutral production and transport
- Net-positive environmental impact
- Net-positive contribution to biodiversity
- Zero pollution of land and sea
- Zero harmful emissions
- Use of renewable energy sources
- Resource efficiency (decreasing need for primary raw materials, no use of ground-water, energy efficiency, etc.)

Social
- Zero human rights violations
- Gender equality in all stages of the supply chain
- Elimination of poverty & hunger
- Secure access to food, clean air & water, sanitation, health care
- Meaningful stakeholder engagement
- Support of local development
- Fair compensation for land-use
- Respect for land rights
- Occupational health & safety
- Community health & safety
- Local recruitment
- Knowledge sharing & training

Economic
- Sustainable and responsible investments
- Fair wages
- Transparency
- Zero financial crime
- Fair compensation for land–use, minerals, etc.
- "Unsustainability is unprofitable"
- Companies accept their responsibility
- Absolute decoupling of economic growth from resource consumption & environmental impact
- Level playing field

Mining & Mineral Processing

Environmental
- Zero hazardous tailings discharge
- Re-use of tailings & waste rock
- Better-than-before reclamation
- Efficient processing, incl. energy & water efficiency, improved recovery
- Efficient use of deposit
- Remediation of abandoned mines

Social
- Formalisation of ASM sector & full integration in the supply chain
- Cooperation between LSM and ASM
- Conflict-free mineral supply chains
- Sharing of infrastructure (especially in remote areas)
- Ensuring water availability & quality for neighbouring communities
- Free prior informed consent

Economic
- Proof of origin & traceability of minerals
- Transparent granting of mining licences
- Use of new technologies & automation
- Multi-stakeholder governance
- Local content in value chain

Cell Manufacturing

Environmental
- Eco-design & collaboration of manufacturers and recycling plants
- Responsible use of toxins, use of alternative substances if possible
- Recovery of solvents
- Increased input of secondary materials
- Use of renewable energy
- Reduced energy input (e.g. utilise waste heat)

Social
- Local value creation
- Occupational health & safety

Economic
- Abandonment of "the cheaper the better" philosophy
- Support of responsible production practices upstream
- Local sourcing where possible
- Process optimisation

Recycling

Environmental
- Circular economy—closed loop & zero waste culture
- Recycling of all recyclable materials used in Li-ion batteries
- Evaluate used Li-ion batteries regarding 2nd life opportunity
- Eco-design & collaboration of manufacturers and recycling plants
- No dumping of toxic materials in landfills

Social
- Maintaining air quality
- Maintaining water quality
- Health and safety in collection, transport and recycling
- Occupational health & safety

Economic
- Financially more attractive than primary raw materials
- Landfilling is forbidden
- Innovation-friendly environment
- Adequate legal basis for recycling
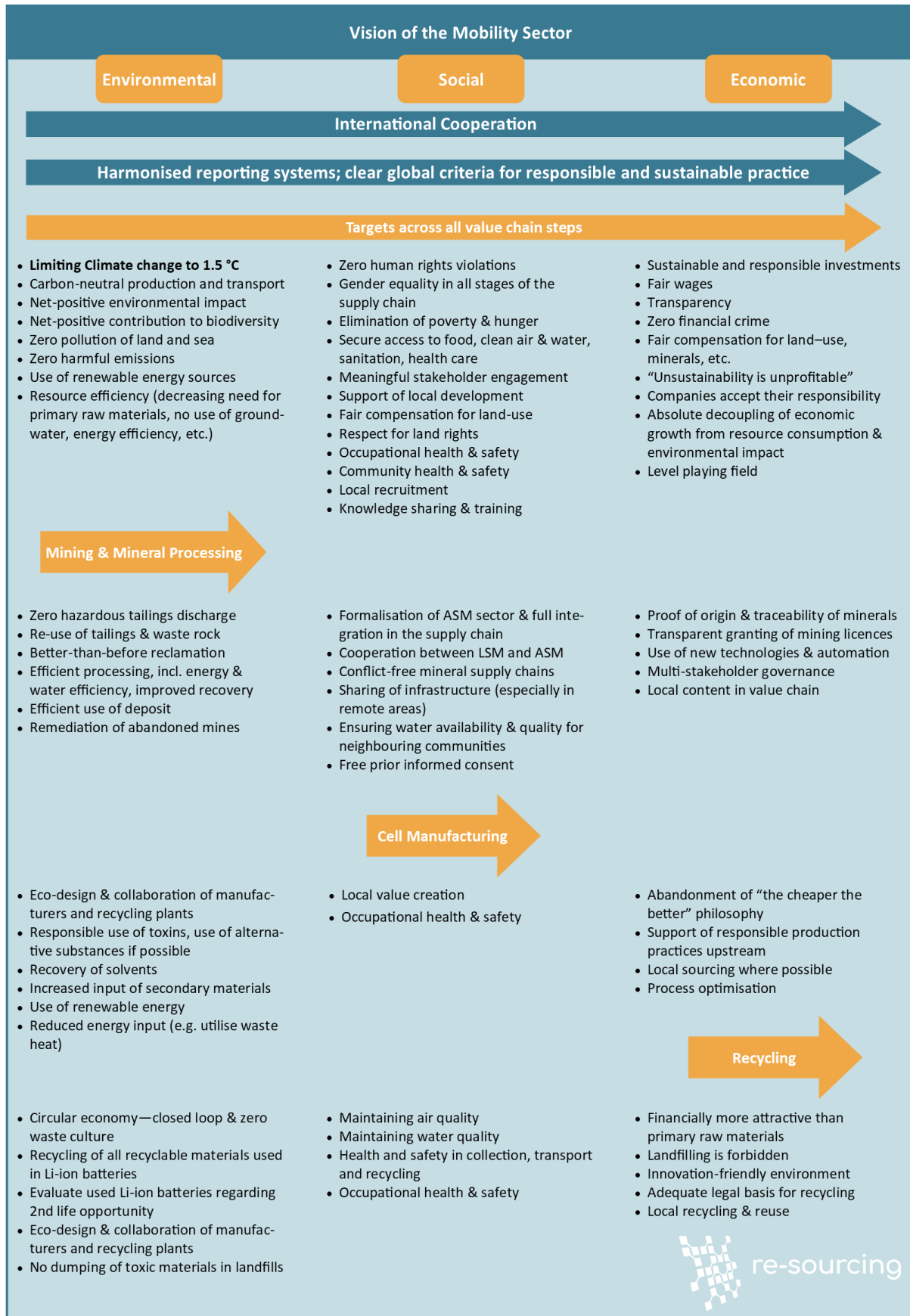- Local recycling & reuse

Figure 3: Vision for the mobility sector (Betz et al. 2021)

2 Pathway

The three overarching targets of the circular economy & decreased resource consumption, responsible procurement and level playing field are based on the concepts of the Paris Agreement, planetary boundaries and strong sustainability. Some approaches to reach these targets overlap each other as illustrated in Figure 4. There are therefore some cross-references between the target chapters.

The following paragraphs explain the roadmap's scope, assumptions and limitations, and structure. In order to have a uniform project structure, these explanations are similar in the three sectors of the RE-SOURCING project.

Figure 4: Three roadmap targets and overlaps

Scope

The RE-SOURCING project provides a roadmap encompassing recommendations for actions for policy makers, industry and civil society. It does not propose new standards or guidelines for the mining step, nor does it attempt to 'reinvent the wheel'. For many areas, appropriate standards have already been developed and the first and most important step is to successfully implement these. Due to the existence of different standards and certification schemes, it is crucial to harmonise these standards. Alignment and mutual recognition are needed to avoid confusion for users and customers in the implementation. Implementation, alignment and mutual recognition of these standards is part of the roadmap's recommendations. It is important to have the foundation in place before thinking bigger. There is ample evidence of companies which, for example, do not respect basic human rights, or governments that fail to address the sustainability principles for protecting local communities.[5]

The State of Play report serves as a basis and baseline for the development of concrete recommendations for policy makers, industry and civil society for moving ahead from this baseline to the RE-SOURCING project's vision for 2050. In this document, the recommended actions for civil society can be considered at a global level. The RE-SOURCING project recognises the important role of investors, insurance, logistics providers and other business service providers. However, they are out of scope for this roadmap as they are relevant for all three sectors (renewable energy, mobility, and electric and electronic equipment) included in the RE-SOURCING project.

As with the State of Play report, the roadmap focuses on the raw materials lithium, nickel, cobalt and graphite, the technology of the LIB and the supply chain stages mining, cell production and recycling. This scope was defined at the start of the project as part of the consultation. There are, of course, numerous other minerals and metals that are essential for the mobility sector, and many of the recommendations listed here can also be applied to other raw materials.

---
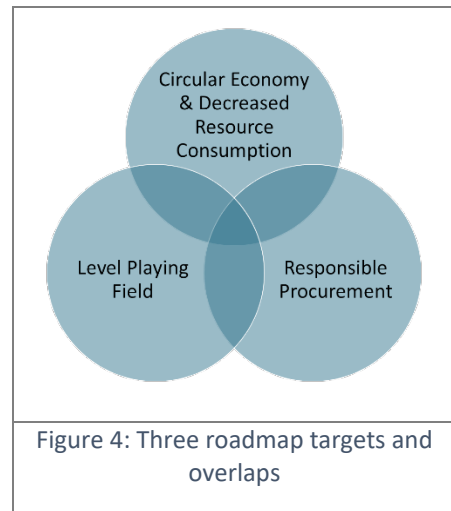
[5] For further information on sustainability challenges in the mobility sector supply chains, as well as existing standards and initiatives, please refer to the State of Play and Roadmap Concept report for the mobility sector.

Assumptions and limitations

The RE-SOURCING project roadmap for the mobility sector assumes technological advances but does not specifically address this issue, apart from the continuation of these advances and the necessary support from the public and private sectors. More information on the technological aspects can be found in various reports, such as Fraunhofer ISI (2015; 2022) and Battery 2030+ (2020).

The roadmap assumes the continuance of wider development and governance issues that address improved governance and business environments in a number of EU partner countries. This would include efforts to address poverty and to raise income levels, creating education and employment opportunities, and addressing gender and human rights at the country, non-sectoral level. This is addressed through support provided by EU Member States development institutions (such as GIZ, SEDA) as well as international organisations (World Bank, UNEP, etc.). This roadmap should therefore be considered as part of the larger development landscape where the wide-ranging challenges for governance and development are being tackled through multiple avenues.

The conclusions from the consultation process indicate the difficulty in setting specific targets for the use of secondary raw materials, the circular economy, etc., as the necessary research has not been fully carried out at this stage by either this project or other external stakeholders. Nevertheless, this report attempts ambitious but realistic assumptions indicating the pathway to achieve the three targets. This aspect will be highlighted in the relevant sections of the report.

Structure

The roadmap differentiates between targets and milestones. **Targets** define the desired end points and are kept at a high and aggregated level. They can be medium- (2030 and 2040) or long-term (2050). Targets were developed during a consultation process with the project's Platform Steering Committee and Advisory Board, as well as the Roadmap Workshop with participants from various stakeholder groups of the mobility supply chain. The targets consider all three pillars of sustainability: social, economic and environmental (Figure 5).
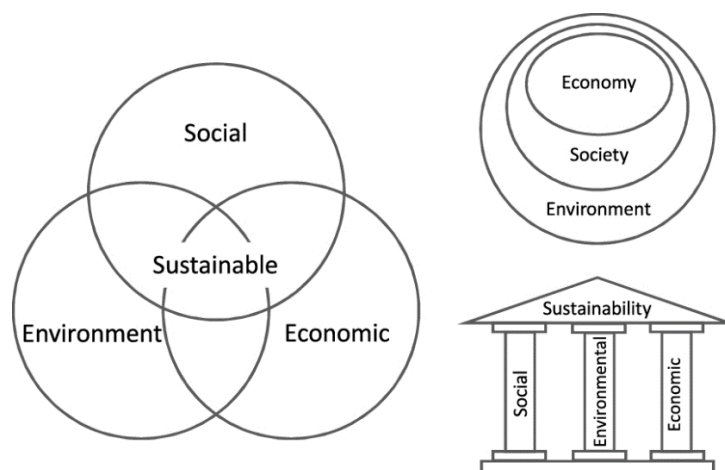

Figure 5: Depictions of the three sustainability pillars - social, environmental and economic (Purvis et al. 2019)[6]

---

[6] Please refer to the report The International Responsible Sourcing Agenda for more information on sustainability and responsible sourcing approaches.

Milestones are points along the desired trajectory from baseline to target and are intended to help track progress. They can be short- (2025), medium- (2030 and 2040) or long-term (2050). While 2025 milestones may appear as short-term considerations, they refer to the achievement of commitments already made or set the direction for future goals. Wherever possible, milestones are specified according to desired quantity, quality and/or time (Capacity4dev Team 7/8/2016). Milestones also include existing and agreed goals, such as the Sustainable Development Goals (SDGs) of the United Nations (UN) and the Paris Agreement.

However, the RE-SOURCING mobility sector roadmap only focuses on targets and milestones that are relevant for and an issue in the focus of the mobility sector. Targets and milestones that are not mentioned here are therefore not considered irrelevant but are beyond the scope of this roadmap. Nevertheless, there are milestones that can be transferred to other sectors, such as the global mandatory supply chain due diligence for all international actors by 2040.[7]

The classification of the milestones and recommendations into categories is based on the authors' preference and should not be regarded as absolute. The time frame for the achievement of milestones and targets shows the latest deadline. However, earlier completion is strongly encouraged.

The **term 'responsible sourcing'** is not considered as a simple supplier-manufacturer business transaction in the RE-SOURCING roadmap for the mobility sector. In this project, the term represents the idea that RS engages **all stages of the supply chain** and should be understood as a joint effort to make each stage sustainable. The recommended actions and milestones that follow therefore do not merely focus on procurement but on all stages of the supply chain, and touch upon sector-specific issues.

Recommendations were developed by the report team and discussed and further revised during the consultation process. The authors' aim is to set recommendations that are ambitious but also realistic, in order to achieve the milestones and targets. The recommendations were developed for policy makers, industry and civil society; however, this document focuses only on CSOs. The recommendations are also divided between the three steps of the mobility roadmap: mining, cell production and recycling. This differentiation represents the authors' view and is illustrated with the following icons in the text:

- ■ Mining
- ■ Cell production and OEMs (Original equipment manufacturer)
- ■ Recycling

---

[7] See also the Roadmap for the renewable energy sector.

2.1 Target 1: Circular Economy & Decreased Resource Consumption

A Circular Economy is a framework based on three principles:

- Eliminate waste and pollution
- Keep products and materials in use
- Regenerate natural systems

It therefore goes beyond recovering resources from waste through recycling by including sufficiency[8], the intensified use of a product and the rehabilitation and secondary land-use of mine sites after production.

As described in the [Roadmap for the renewable energy sector,](#) continuing with business-as-usual consumption patterns while using renewable energy can be described as a 'low-carbon destruction of planetary resources' (Swilling 2020, p. 101). New systems for both consumption and production are required to satisfy human needs and universal wellbeing while staying within planetary boundaries (Brand-Correa and Steinberger 2017; Raworth 2017; Swilling 2020).
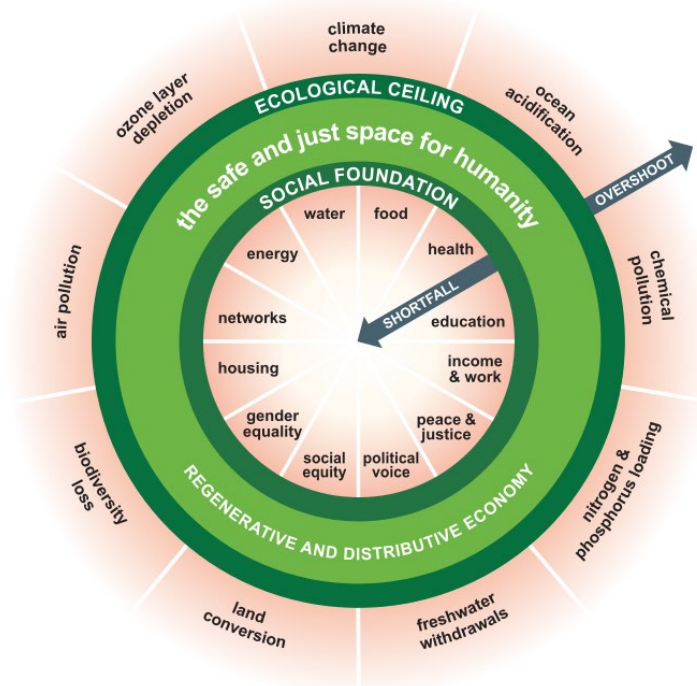

Figure 6: Doughnut Economics - combining social and planetary boundaries (DEAL 2021)

Absolute decoupling of economic growth, resource consumption and environmental impact is one of the proposed measures to tackle price shocks and resource scarcity and to halt environmental degradation (UNEP 2014). Decoupling relies on decreasing resource consumption by improving

---

[8] For more information about sufficiency, see Thomas Princen's book 'The Logic of Sufficiency' published in 2005, in which he argues that 'seeking enough when more is possible is both intuitive and rational - personally, organizationally and ecologically. And under global ecological constraint, it is ethical.' (Princen 2005)

resource efficiency through technological improvements, substitution of non-renewable by renewable resources, waste prevention through reuse and recycling, etc. The concept of decoupling also faces criticism as current research has not reached a consensus on whether absolute decoupling of economic growth, consumption and environmental impact is in fact possible (Parrique et al. 2019; Strand et al. 2021; Wiedmann et al. 2020). Similarly, 100% circularity of resources within an economy will not be possible, due to physical and economic constraints and in some cases will not be desirable due to the high negative environmental impacts of certain recycling processes driven to their limits (Moss 2019; UNEP 2013).

This roadmap follows a two-pronged approach for the mobility sector: (i) increasing resource efficiency, recycling and reuse rates is a prerequisite for achieving the transition away from fossil fuels and meeting the growing demand from a growing population and (ii) reengineering the current economic system with a focus on changing existing consumption patterns. These considerations are addressed by the Doughnut Economics Principles of Practice: 'Think in systems' – aim for continuous improvements; 'be regenerative' – the 6Rs of sustainability (reduce, reuse, recycle, repair, rethink and refuse); and 'aim to thrive rather than grow' (DEAL 2021).

Following this approach, the project came up with several milestones to be achieved over the coming decades. To achieve these milestones, a set of recommendations for actions are outlined. As mentioned earlier, the recommendations in this document are aimed at CSOs.

This report does not directly address research and academic institutions but does include some recommendations for these stakeholders to support a circular economy. They have a primary role in developing new technologies and advancing existing ones to reduce both the resources and the energy used in their production. It is also important for them to pay attention to the subsequent reuse and recovery of materials when designing products (design for recycling). When developing new technologies in the future, attention must be paid to the raw materials used from the very beginning. Interdisciplinary cooperation should be significantly improved and expanded for this purpose. Direct cooperation with industry needs to be intensified to effectively develop viable new products. Interdisciplinary cooperation should be strengthened not only in the technical field in relation to the use of raw materials, but also between engineering, social sciences, ecology, sustainability research, etc. Environmental and social impacts have to be considered, for example in the form of (social and environmental) life-cycle assessments, and in product development from the start of a project.

Civil Society Organisations (CSOs) are already important contributors to the achievement of sustainability in the whole value chain of the mobility sector in general and LIBs in particular. It is important to differentiate between international/local CSOs, advocacy CSOs, labour unions, community groups and others. These are all included in these milestones and recommendations. Each of them has an important part to play, e.g., as a counterpart of the industry or policy makers, including bringing the view of civil society into the discussion. The latter can be a powerful ally; however, they have to be informed and educated. The power of CSOs to change things lies in reporting, monitoring, communication, and engagement and education of the public. The milestones and recommendations show this particular role. For the challenges ahead, CSOs are crucial to encourage and move the public towards more sustainability, a circular economy and decreased resource consumption. The main sub-targets can be summarised as:

- Inform the public and build capacity with information campaigns and engagement (on the circular economy, alternative transport, sustainable LIBs, sufficiency and personal responsibility)
- Engage in strong standards and discourses with other stakeholder groups and internally
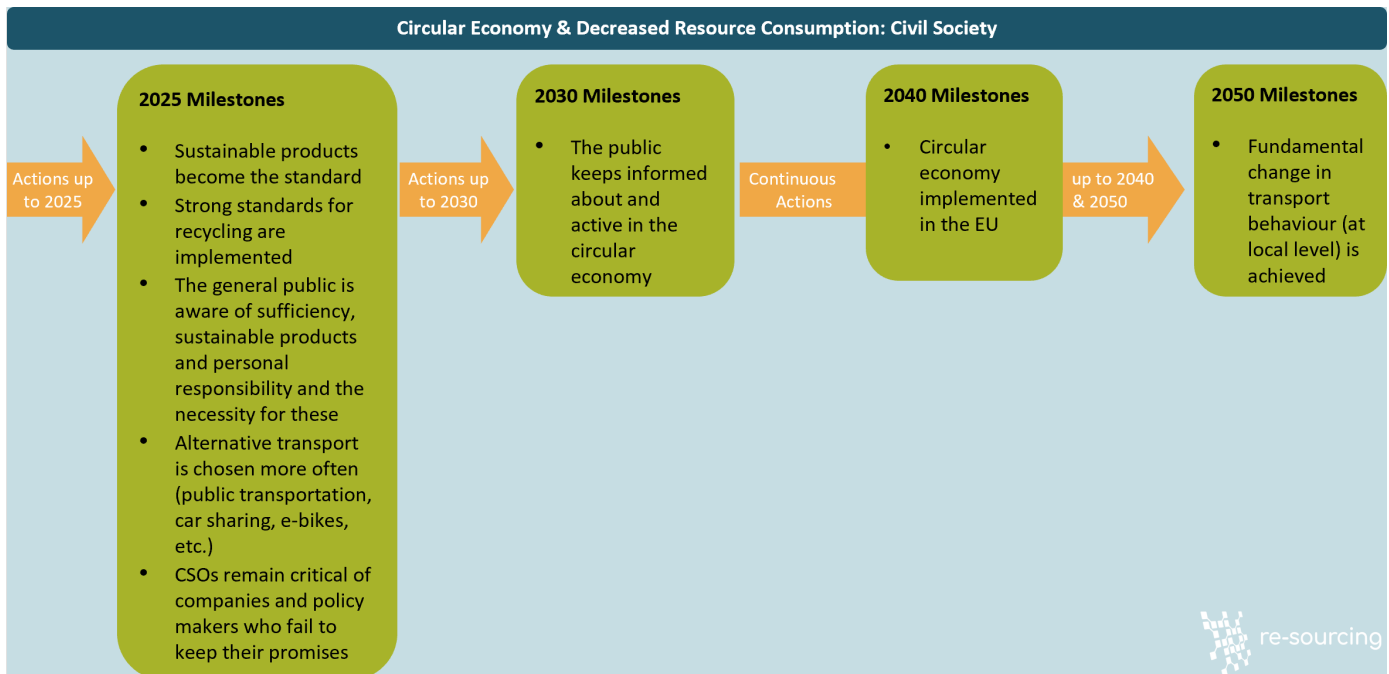- Remain critical

Circular Economy & Decreased Resource Consumption: Civil Society

Actions up to 2025

2025 Milestones
- Sustainable products become the standard
- Strong standards for recycling are implemented
- The general public is aware of sufficiency, sustainable products and personal responsibility and the necessity for these
- Alternative transport is chosen more often (public transportation, car sharing, e-bikes, etc.)
- CSOs remain critical of companies and policy makers who fail to keep their promises

Actions up to 2030

2030 Milestones
- The public keeps informed about and active in the circular economy

Continuous Actions

2040 Milestones
- Circular economy implemented in the EU

up to 2040 & 2050

2050 Milestones
- Fundamental change in transport behaviour (at local level) is achieved

Figure 7: Milestones for civil society towards a circular economy and decreased resource consumption by 2050

2.1.1 Milestones 2025

- **Sustainable products become the standard**

For the circular economy to work – also from a business perspective – there has to be a willingness to make the right choices when buying products. This often includes the willingness to pay a premium in exchange for a sustainable product and forcing companies to make this choice. CSOs have to lead the discussion with policy makers, industry and the general public about sustainable products becoming the standard. They also have to advocate for the poor, who have to be (financially) supported to be able to afford sustainable products.

First, this involves the definition of a sustainable product by policy makers. The topic of resources and BEVs are discussed critically, at least in some parts of society. CSOs have to steer this conversation in the right direction. Furthermore, other topics such as raw material use, and reuse of products and their reparability have to be brought onto the agenda and be included in the purchase decision.

Recommendations:

- Promote sustainable products (raw materials used, reuse, long-lasting, reparability)

- **Strong standards for recycling are implemented**

♻ There are many (voluntary) standards for mining, which serve as a basis for additional mandatory legislative requirements. However, recycling is often seen as sustainable by itself, without looking into the details. The well-known examples of copper and lead being recycled by the informal sector in a scrap yard in Ghana by burning cables or scraping off lead paste in an open smelting furnace give an indication that a lot can go wrong in recycling. In addition, recycling LIBs can be conducted in a poor fashion leading to environmental burdens and health issues due to the dangers of fires and toxicity. Strong recycling standards (voluntary and mandatory) are thus necessary to avoid such challenges from the start. These have to be developed by bringing together all the actors, but the CSOs could play a leading role and start the discussion.

Furthermore, CSOs can identify pilot projects, promote better training, deploy external experts to help, and source and provide safety equipment. Good practices from the mining sector can be transferred to the recycling step. According to the good practice guidance document, a strong standard includes the standard development with all stakeholder groups with the same voting rights, engagement with local stakeholders such as workers and communities, mandatory transparency of the audit and results towards the public, consultation with the company and the opportunity for corrective actions to be undertaken (see Degreif et al. 2022).

Recommendations:

- Implement strong recycling standards together with all actors

- **The general public is aware about sufficiency, sustainable products and personal responsibility and its necessity**

CSOs can make an important contribution to increasing resource efficiency and reducing energy demand by increasing awareness and informing citizens about the impact of consumption patterns and possible alternatives. For example, increase awareness of issues such as the impact of buying a new mobile phone every year, what raw materials are needed for it, where they come from, and their environmental and social impacts and the necessity for recycling. Consumers need to be better informed about the consequences of continuing their current consumption patterns. In this area, the necessary and desirable cooperation with policy makers should be emphasised. On the one hand, this 'educational work' is necessary at the political level, on the other hand, political measures to increase resource efficiency can be developed and communicated jointly to the public.

Personal responsibility must also be made clear. The general public cannot change everything. However, they have the power of a vote in a democracy, and, at the end of the day, every product is made for a consumer to buy. The public, policy makers and industry can only make the transition to a circular economy if they are informed and interested in the topic.

Recommendations:

- Educate and inform the general public, policy and industry on sufficiency and personal responsibility and why it is crucial

- **Alternative transport is chosen more often (public transportation, car sharing, e-bikes, etc.)**

Without a decrease in resource use in car manufacturing, it will be difficult to achieve the overarching principles of the circular economy. It is therefore important that measures are taken to make other, less resource- and energy-consuming modes of transport more available and attractive. As with a free market economy, the choice of transport is mostly the responsibility of the customer. CSOs also have to do their part to inform the general public about the advantages and necessity to use alternative means of transport, even if the other choice would be more convenient.

Recommendations:

- Educate and inform the general public on sufficiency and personal responsibility and why it is crucial to use alternative means of transport

- **CSOs remain critical of companies and policy makers failing to keep their promises**

As the general public is often not adequately informed, it is the duty of the CSOs to take their place and publicise situations where policy makers and industry are failing to keep to their goals and promises. They need to steer the indignation of the general public in the right direction, but also praise policy makers and industry when they do make reasonable progress. The task is to always keep the next step in mind.

Recommendations:

- Educate people to ask industry and policy makers to change

2.1.2 Milestones 2030

- **The public keeps informed about and active in the circular economy**

Informing the public once about an issue will not help to keep them informed and active. A good example is the oil companies, which are often forgotten when the mobility sector is criticised for the extraction of resources. This means that CSOs should not tire of reminding the general public of the challenges in the mobility sector and how to achieve a circular economy.

Recommendations:

- Keep the public educated about the circular economy

2.1.3 Milestones 2040

- **Circular economy implemented in the EU**

A circular economy can only be achieved if the public makes the right choices and calls on policy makers and industry to act accordingly. This is the role that civil society organisations must play. They should inform the public and always show policy makers and industry the next step, while at the same time pointing out when they are not keeping their promises.

Recommendations:

- Continue all efforts for achieving a circular economy and reducing resource consumption

2.1.4 Milestones 2050

- **Fundamental change in transport behaviour (at local level) is achieved**

By 2050, the number of cars should be drastically reduced and the shift towards other means of transport achieved, especially in larger cities where there should no longer be any need for private cars. This is only possible if the general public also demands this change and creates the political majorities to enable policy makers to act. CSOs have to lead this change by informing the general public about the advantages and the necessity for change without dividing society. This also means continuing all the efforts for achieving a circular economy and a reduction of resource consumption.

Recommendations:

- ▪ Support the circular economy in every possible way as mentioned previously

2.2 Target 2: Responsible Procurement

As described in the roadmap for the renewable energy sector, responsible or sustainable procurement is defined as 'the process of making purchasing decisions that meet an organisation's needs for goods and services in a way that benefits not only the organisation but society as a whole, while minimising its impact on the environment' (ISO 2017, p. 2). The authors understand this citation to mean that organisations need to consider not only their own impact – positive and negative – from production or procurement but also the **associated impacts along the whole supply chain.** Value should be created wherever possible along the chain, especially at the mining site. It is important to note that there are differences between adverse impacts caused by, contributed to by, or directly related to the company's activities, products or services through a business relationship.[9]

However, it should be mentioned that the authors do not recommend ending business relationships with suppliers or countries that do not adhere to the required social and environmental standards to achieve responsible sourcing. The vision is rather to engage with and support them in improving their performance. Wilful use of forced and child labour, environmental pollution and other irresponsible practices at any stage of their supply chain should not be accepted from companies that want to have business relations and do business in or with the EU.

The recommendation to introduce a global mandatory supply chain due diligence for all international actors by 2040 is not intended to undermine current efforts by countries to introduce such a law. The time frame proposed in this roadmap, as mentioned in the introduction of Chapter 2, is only the latest date by which these measures should be implemented. It is also intended to encourage countries that are not yet planning to implement such measures to do so and to provide recommendations on what to include.

The milestones and recommendations in this chapter support the following sub-targets for CSOs:

- Research and report on relevant aspects (transparency, SLO, procurement)
- Inform the public with information campaigns (SLO, responsible procurement)
- Engage meaningfully with other stakeholder groups
- Build capacities on the ground
- Remain critical

---

[9] For further information, see the OECD Due Diligence Guidance for Responsible Business Conduct (OECD 2018, page 70). Additional information is given in the OECD guidelines for Multinational Enterprises (OECD 2011) and OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (OECD 2016).
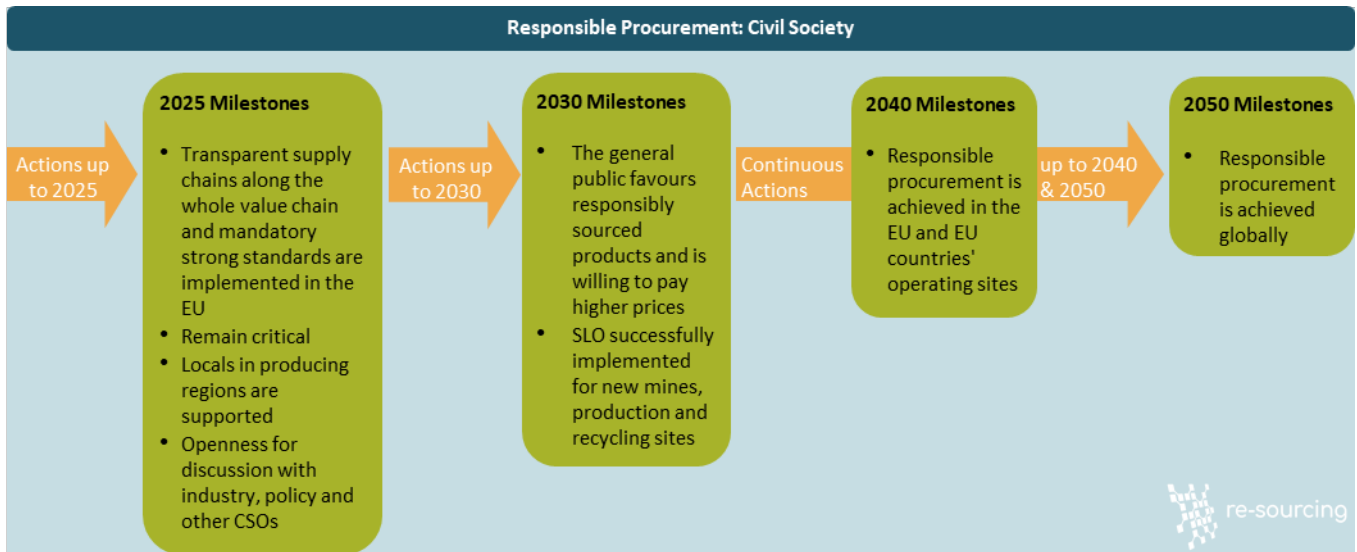
Figure 8: Milestones for civil society towards a responsible procurement by 2050

2.2.1 Milestones 2025

- **Transparent supply chains along the whole value chain and mandatory strong standards are implemented in the EU**

Transparency and strong standards are essential in order to achieve responsible sourcing along the supply chain. Civil society should support the other stakeholder groups in achieving this goal by pushing initiatives to extend strong mining standards to cover more resources and to include smelting and recycling. This support should take the form of publishing reports, evaluating good practice examples and showing the advantages of using and extending strong standards as well as demonstrating the disadvantages of the current situation. Furthermore, CSOs should engage meaningfully in developing standards further and take an active role, when offered.

Recommendations:

- Research and publish good practice examples and advantages
- Engage in the further development of standards
- Push initiatives to extend strong mining standards to include more resources, smelting and recycling

- **Remain critical**

CSOs should push industries and policy makers to implement responsible procurement and criticise them for failing to keep their promises. CSOs need to remain critical and interested and request data. This includes the procurement processes and approaches in producing companies. The data should be comprehensively prepared by the organisations, for example, by promoting good practice examples as well as publishing bad examples. To make information understandable for end consumers, CSOs should provide a list of sustainable products. In the case of LIBs, the labelling

introduced for LIBs by policy makers in 2025 (see Chapter 2.2.1.1 in the [Roadmap for Responsible Sourcing - Mobility](#)) should be used for this purpose.

CSOs also need to raise public awareness about responsible procurement, e.g., by information campaigns.

Recommendations:

- Promote good practice examples as well as publish bad examples
- Raise public awareness about responsible procurement
- Provide a list of 'sustainable products' for end consumers

- **Locals in producing regions are supported**

Another important topic is the support of locals in producing regions (mining, cell production, OEMs, recycling). CSOs should support capacity building on the ground, in order to make the civil voice better prepared for discussion with local politics and industry players. CSOs also need to engage in local events to present or support the locals' voice. Even though CSOs support the locals' voice, they need be open for discussion and debate with the other stakeholder groups.

Recommendations:

- Support locals through capacity building on the ground and meaningful engagement

- **Openness for discussion with industry, policy and other CSOs**

CSOs should stay open for discussions with industry and policy. They should remain as objective as possible in their interpretations and seek dialogue. CSOs should continue to be engaged meaningfully, e.g., in the development of a standard, because their perspective is necessary. As CSOs often have limited capacity, it can be useful to create expert representation. A balanced approach must be considered in the process. With financial support from the policy makers, further capacity on the ground and CSO internally should be built to ensure meaningful engagement with the different stakeholder groups.

In addition, space must be created for a debate, exchange and discussion between CSOs with different perspectives, e.g., the global North and the global South.

Recommendations:

- Engage in discussions with other stakeholder groups and other CSOs

2.2.2 Milestones 2030

- **The general public favours responsibly sourced products and is willing to pay higher prices**

To create a demand for responsibly sourced products and thus more opportunities to meet it, by 2030, the general public need to be aware of and favour responsibly sourced materials and be willing to pay higher prices. CSOs can help to achieve this by educating and informing the general public on sufficiency and personal responsibility and why these are crucial. The recommendations mentioned previously are also important.

Recommendations:

- Educate and inform the general public on sufficiency and personal responsibility and why these are crucial

- Promote good practice examples as well as publish the bad examples

- Raise public awareness about responsible procurement

- **SLO successfully implemented for new mines, production and recycling sites**

A Social License to Operate (SLO) is key, especially for mines but also for production and recycling sites. It ensures the inclusion of the public perspective.[10] By 2030, SLO should be successfully implemented for new mines, cell production and recycling sites. CSOs can support the SLO implementation and continuation by meaningful engagement in the discussion between companies and the public.

Recommendations:

- Enable SLO by engaging in the discussion between companies and the public

---

[10] According to JRC, a formal and agreed definition of SLO is not yet available 'The concept of "Social Licence to Operate" (SLO) refers to a local community's acceptance or approval of a project or a company's ongoing presence, beyond formal regulatory permitting processes (e.g., public hearing and rights for written interventions). SLO derives from the acknowledgement that stakeholders may threaten a company's legitimacy and ability to operate through boycotts, picketing or legal actions. From a company perspective, obtaining a SLO is essential for reducing the risk of public criticism, social conflict and damage to the company reputation, which could reduce its profitability.' (JRC 2022).

2.2.3 Milestones 2040

- **Responsible procurement is achieved in the EU and EU countries' operating sites**

By 2040, responsible procurement is achieved in the EU and EU countries' operating sites by reaching the preceding milestones and recommendations. This milestone is reached by all stakeholders implementing the suggested recommendations.

Recommendations:

- Follow all preceding milestones and recommendations

2.2.4 Milestones 2050

- **Responsible procurement is achieved globally**

By 2050, responsible sourcing needs to be achieved globally by reaching the preceding milestones and recommendations. To reach this milestone, information campaigns and publications on good and bad examples need to be carried out continuously. In order to reach the population, attention must always be paid to understandable language and the use of the local language.

Recommendations:

- Continuous information campaigns and publications
- Use of understandable and local language

2.3 Target 3: Level Playing Field

The consultation process showed that the development of a level playing field (not only) for the mobility sector needs to be one of the major targets in a roadmap for responsible sourcing in the mobility sector. The current system focuses on producing the cheapest product, mostly ignoring the way in which the products are produced and their quality or durability. This system encourages companies to locate production in countries with low social and environmental standards and is based on a 'throwaway society'.

With globalisation, supply chains do not end at EU boarders, so the RE-SOURCING project supports the idea of a joint effort to reach more responsible supply chains globally. The roadmap not only encourages the introduction of requirements for social and environmental standards for doing business in the EU but puts forward milestones and recommendations that include cooperation with and support for companies, organisations and governments that currently do not fulfil those requirements globally.

A level playing field should achieve a fair distribution of costs and benefits along the supply chain.

In the discussion about a level playing field, seven main issues are of relevance:

- Quality over Price
- International cooperation
- Producer Responsibility
- Polluter Pays and Border-Tax Adjustment
- Harmonisation of mining and production policies
- Harmonisation of sustainability and reporting criteria
- Formalisation of artisanal and small-scale mining (ASM)
- Mandatory minimum standards

In the beginning of each chapter, figures provide an overview of the milestones for supporting the target of level playing field identified in the project. To achieve these milestones, a set of recommendations for actions are outlined. In the following sub-chapters, the milestones and recommendations are developed for the different stakeholder groups: EU policy makers, internationally operating companies and CSOs.

In the sub-chapters, the milestones are given as bulleted lists in bold type. The explanations and their recommendations follow each milestone. For quick access to the recommendations for action, these are summarised in the coloured boxes at the end of each milestone.

CSOs need to support the achievement of a level playing field with these sub-targets:

- Research and report on relevant aspects
- Inform the public through information campaigns and capacity building on the ground
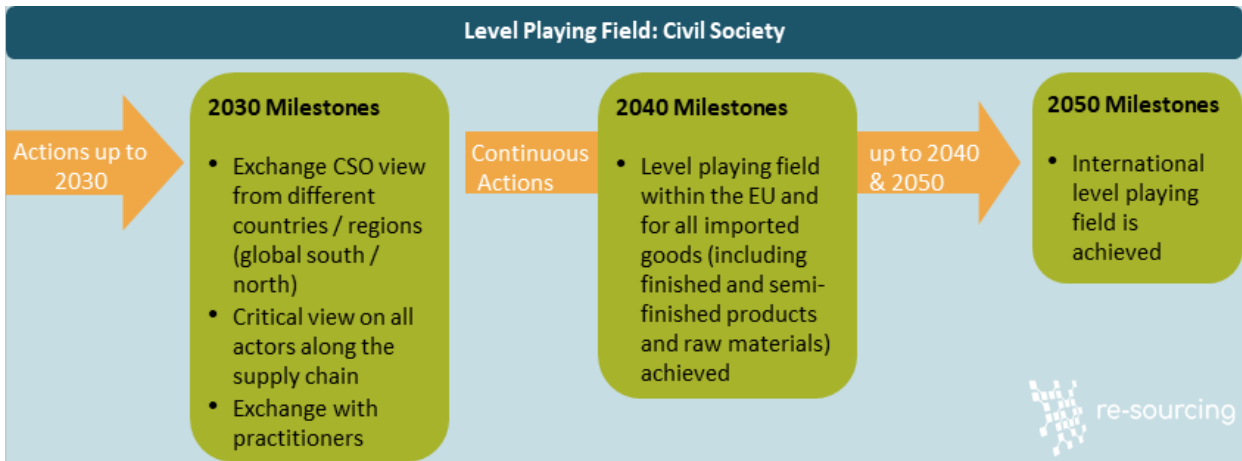- Engage with other CSOs and other stakeholder groups
- Remain critical

Figure 9: Milestones for civil society towards a level playing field by 2050

2.3.1 Milestones 2030

- **Exchange CSO view from different countries/regions (global South / North)**

The challenges in mining, cell production and recycling differ in the regions, e.g., the north and south of the EU, but also the global North and global South. Civil society should exchange ideas internally between the different regions and learn from each other's experiences in various sustainability aspects associated with mining, cell production and recycling.

Recommendations:

- Internal exchange EU-wide and globally on sustainability aspects in mining, cell production and recycling

- **Critical view on all actors along the supply chain**

Civil society fulfils a unique role by bringing critical aspects to light in all steps of the supply chain, including mining, cell production and recycling. This role is essential to alert policy makers and industry to challenges (known challenges as well as new topics) and make these public. These critical topics are related to environmental aspects (e.g., water) as well as social and local issues (e.g., local development).

In this role, civil society should point out the shortcomings, but also promote good practice examples and approaches to show industry how to proceed. The public tends to trust CSO/NGO information. For example, a clearly written NGO/CSO publication on ASM could transform the public's critical view of ASM material into a more neutral and supportive view of ASM and ASM formalisation projects.

But CSOs shall also help and support communities in discussions with industry and policy (see also the recommendations in target 2 'Remain critical', 'Locals in producing regions are supported', 'Openness for discussion with industry, policy and other CSOs')

Recommendations:

- Publicise black sheep and problems but also good practice examples
- Raise awareness of the necessity of a level playing field

- **Exchange with practitioners**

CSOs/NGOs get their information from the internet or obtain it through interviews. To obtain an overarching view of a topic, the exchange with practitioners (industry) is essential. An open discussion and exchange covering the arguments between industry and NGOs should be obligatory for both sides. This should include general topics, but also responsible / sustainable mining in Europe (see also milestone above 'Critical view on all actors along the supply chain'). Information campaigns on the necessity for raw materials but also on the requirement for the mining sector to change to a sustainable production and the value of secondary material could serve as a basis for discussions on

an equal footing based on facts from all stakeholder groups (industry, policy, NGOs/CSOs and the public).

> **Recommendations:**
>
> - Be open for discussion on an equal footing with practitioners
> - Push industry to become sustainable
> - Information campaign about sustainable mining in the EU, the necessity of raw materials and value of secondary raw materials

2.3.2 Milestones 2040

- **Level playing field within the EU and for all imported goods (including finished and semi-finished products and raw materials) achieved**

The overarching target of an international level playing field should be achieved in part. With fulfilling the above-mentioned recommendations for CSOs in combination with industry and policy makers, a level playing field within the EU and for all imported goods should be achieved by 2040.

> **Recommendations:**
>
> - Follow the recommendations mentioned before
> - Be open for discussion on an equal footing with practitioners and policy makers within the EU and from countries where goods are imported from to the EU
> - Continuous communication with stakeholders from different regions and supply chain steps within the EU and countries from which goods are imported into the EU

2.3.3 Milestones 2050

- **International level playing field is achieved**

By continuing the recommendations, the level playing field can be expanded. By 2050, an international level playing field should be achieved. International exchange and communication between different stakeholders from different regions are essential.

> **Recommendations:**
>
> - Follow the recommendations mentioned before
> - Be open for discussion on an equal footing with practitioners and policy makers
> - Continuous communication with stakeholders from different regions and supply chain steps

2.3.4 Role of International Organisations (UN/OECD/IFC)

The LIB supply chain is very complex and has a globally interlinked structure. This applies not only to the LIB sector but also to renewable energy and electronics.[11] It is therefore important that international organisations, such as the United Nations and OECD, are strengthened. These organisations can make an important contribution to a level playing field and to harmonising requirements for companies globally. To make it easier to hold internationally active companies accountable for financial crimes as well as crimes against the environment and humanity, the role of the UN's international justice system should also be extended to companies.

The UN, OECD and IFC already provide important templates for responsible behaviour by international companies in general. In addition, there are specific guidelines for mining, manufacturing, and responsible sourcing of raw materials, all either specific to or applicable to the commodities under consideration. These guidelines need to be implemented by member states on a mandatory basis and without delay, thereby also supporting an international level playing field.

---

[11] See also the roadmap on renewable energies and the state-of play report on electronics.

3   Conclusion of the overall Roadmap

Even though the roadmap has a time frame until 2050, it is clear that there is no time to waste - we **need to act now**! Changes are needed and cannot be postponed to the next generation or next legislation period. All targets need to be addressed simultaneously and all with the same importance and power from the stakeholder groups. The targets are also interrelated, e.g., to make procurement sustainable by obtaining only responsibly recycled materials, the latter is needed on the market.

One of the key findings of the roadmap and the consultations is the importance of **communication and cooperation between stakeholders along the whole value chain** for all three targets: none of the targets can be resolved by only one stakeholder group. Challenges must be tackled together without ending relationships when problems arise.

A **change in thinking** is needed for all actors – policy makers (e.g., by setting overarching regulations with concrete criteria), industry (e.g., by implementing quality over price), civil society (e.g., by promoting good practice cases) and also the general public (e.g., a change in transport behaviour) – who need to understand, support and embrace the new way of thinking.

A **shared goal** must be pursued. This must be addressed through joint actions with the different stakeholder groups (policy, industry and civil society). The decisions that are taken need to follow this common target to build trust between the stakeholder groups and among the general public. This is also the basis for a change in behaviour. Frontrunners and role models are needed in all stakeholder groups where others can follow.

This roadmap supplies only very few specific details on actual data for increases or decreases. Further **research** is needed to set ambitious but realistic targets and be as precises as possible to define the necessary measures.

A variety of recommendations are developed for all stakeholder groups. Some are specifically for the project's focus on lithium-ion batteries (LIBs) with the materials lithium, cobalt, nickel and graphite. However, recommendations are identified that are valid for other raw materials and other sectors and technologies. This underlines the complexity of raw material supply chains and the interlinkages between the different sectors.

The overview of the three main targets is illustrated in the roadmap figure (see Figure 10). **Target 1 'circular economy & decreased resource consumption'** needs fundamental changes in transport behaviour and also systemic changes for the recycling and use of secondary raw material. By 2040 the circular economy needs to be implemented for LIBs in the EU. In addition, the resource intensity of batteries should be reduced by more than 50% compared to 2021. By 2050 the primary resource consumption for traction batteries needs to be reduced by more than 80% in the EU compared to 2035 and ICEs should no longer be on the roads globally.

The recommendations for **Target 2 'responsible procurement'** and **Target 3 'level playing field'** need to be implemented as soon as possible in order to first reach a common understanding of a 'sustainable product' in the EU and abroad as a basis for implementing a fair distribution of benefits and burdens in the transition to e-vehicles. Responsible procurement in all EU firms (including SMEs) needs to be implemented by 2040, and globally by 2050 at the latest. A level playing field should be achieved within Europe in all three pillars of sustainability by 2030 and globally by 2050 at the latest.
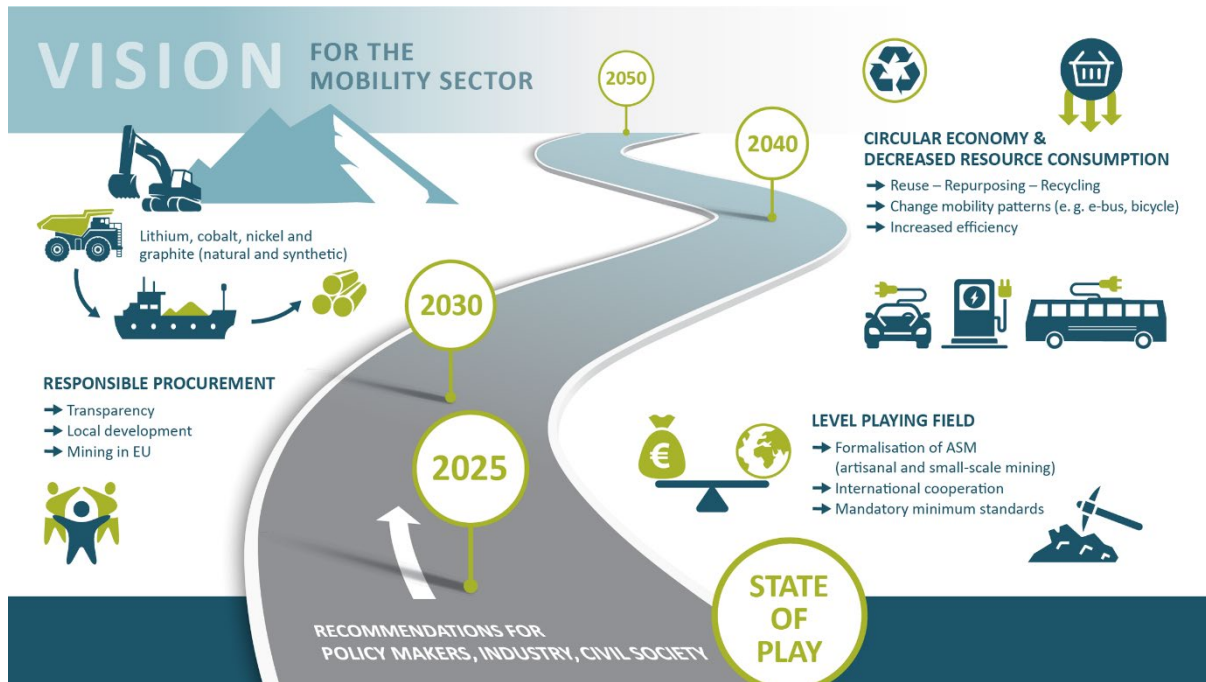
Figure 10: Roadmap for the mobility sector up to 2050

4 Publication bibliography

Battery 2030+ (Ed.) (2020): Inventing the sustainable batteries of the future. Available online at https://battery2030.eu/research/roadmap/, checked on 28/06/2022.

Betz, Johannes; Degreif, Stefanie; Dolega, Peter (2021): State of Play and Roadmap Concept: Mobility Sector. RE-SOURCING Deliverable 4.2. April 2021. Available online http://re-sourcing.eu/reports/sop-mobility-sector/, checked on 01/07/2022.

Bieker, Georg; ICCT (Ed.) (2021): A global comparison of the life-cycle greenhouse gas emissions of combustion engine and electric passenger cars. Available online at https://theicct.org/wp-content/uploads/2021/12/Global-LCA-passenger-cars-jul2021_0.pdf, checked on 28/06/2022.

Brand-Correa, Lina I.; Steinberger, Julia K. (2017): A Framework for Decoupling Human Need Satisfaction From Energy Use. In *Ecological Economics* 141, pp. 43–52. DOI: 10.1016/j.ecolecon.2017.05.019.

Capacity4dev Team (2016): Logical Framework Approach for Project and Programme Cycle Management. Session 10: Indicators (I) - Indicators, baselines, targets and milestones. Methodological Knowledge Sharing programme. Belgium, 7/8/2016. Available online at https://europa.eu/capacity4dev/rom/documents/session-10-indicators-i-indicators-baselines-targets-and-milestones-0, checked on 04/08/2021.

DEAL (2021): About Doughnut Economics. Edited by Doughnut Economics Action Lab. Available online at https://doughnuteconomics.org/about-doughnut-economics, updated on 06/12/2021, checked on 06/12/2021.

Dedeurwaerdere, Tom (2014): Sustainability science for strong sustainability. Cheltenham: Edward Elgar Pub. Ltd. Available online at https://www.elgaronline.com/view/9781783474554.xml, checked on 28/07/2022.

Degreif, Stefanie; Betz, Johannes; Farooki, Masuma (2022): Meeting the Milestones in the Responsible Sourcing Roadmap. Good Practice Guidelines for the Mobility Sector. Available online at http://re-sourcing.eu/reports/d53-guidelines-for-mobility-sector-final-20220629-final-style-guide/, checked on 28/07/2022.

Ekins, Paul; Simon, Sandrine; Deutsch, Lisa; Folke, Carl; Groot, Rudolf de (2003): A framework for the practical application of the concepts of critical natural capital and strong sustainability. In *Ecological Economics* 44 (2-3), pp. 165–185. DOI: 10.1016/S0921-8009(02)00272-0.

European Commission (12/11/2019): The European Green Deal. Brussels, Belgium. Loonela, Vivian; Rietdorf, Lynn; Crespo Parrondo, Ana. Available online at https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691, checked on 29/07/2022.

European Commission, Directorate-General for Mobility and Transport (2021): EU transport in figures: statistical pocketbook 2021, Publications Office, https://data.europa.eu/doi/10.2832/27610, checked on 28/07/2022.

European Commission (2022): Delivering the European Green Deal. Available online at https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en, checked on 28/06/2022.

Fraunhofer ISI (Ed.); Thielmann, Axel; Sauer, Andreas; Wietschel, Martin (2015): Gesamt-Roadmap Lithium-Ionen-Batterien 2030. Available online at https://www.isi.fraunhofer.de/content/dam/isi/dokumente/cct/lib/GRM-LIB.pdf, checked on 28/06/2022.

Fraunhofer ISI (Ed.); Schmaltz, Thomas; Wicke, Tim; Weymann, Lukas; Voß, Philipp; Neef, Christoph, Thielmann, Axel (2022): Solid-State Battery Roadmap 2035+. Available online at https://www.isi.fraunhofer.de/content/dam/isi/dokumente/cct/2022/SSB_Roadmap.pdf, checked on 28/06/2022.

ISO (2017): ISO 20400 Sustainable Procurement. Edited by International Organization for Standardization. Available online at https://www.iso.org/files/live/sites/isoorg/files/store/en/ISO%2020400_Sustainable_procur.pdf, checked on 08/10/2021.

JRC (2022): Joint Research Center: Raw Materials Information System (RMIS): Social Licence to Operate (SLO) https://rmis.jrc.ec.europa.eu/?page=social-licence-to-operate-b86e6d, checked on 20/06/2022.

Moss, Kevin (2019): Here's What Could Go Wrong with the Circular Economy—and How to Keep it on Track. Edited by World Resources Institute. Available online at https://www.wri.org/insights/heres-what-could-go-wrong-circular-economy-and-how-keep-it-track, checked on 28/07/2022.

OECD (2011): OECD Guidelines for Multinational Enterprises, OECD Publishing. http://dx.doi.org/10.1787/9789264115415-en, checked on 28/07/2022.

OECD (2016): OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas. Third edition. Paris: OECD Publishing. Available online at https://www.oecd.org/daf/inv/mne/OECD-Due-Diligence-Guidance-Minerals-Edition3.pdf, checked on 18/08/2021.

OECD (2018): ECD Due Diligence Guidance for Responsible Business Conduct. Available online at https://mneguidelines.oecd.org/OECD-Due-Diligence-Guidance-for-Responsible-Business-Conduct.pdf, checked on 11/07/2022.

Oeko-Institut (2019): Buchert, M.; Dolega, P.; Degreif, S. (2019): Gigafactories für Lithium-Ionen-Zellen – Rohstoffbedarfe für die globale Elektromobilität bis 2050. Available online at https://www.oeko.de/fileadmin/oekodoc/Fab4Lib-Rohstoffe-Elektromobilitaet.pdf, checked on 29/06/2022.

Parrique, Timothée; Barth, Jonathan; Briens, François; Kerschner, Christian; Kraus-Polk, Alejo; Kuokkanen, Anna; Spangenberg, Joachim H. (2019): Decoupling debunked: Evidence and arguments against green growth as a sole strategy for sustainability. Edited by European Environmental Bureau.

Princen, Thomas (2005): "The Logic of Sufficiency". https://mitpress.mit.edu/books/logic-sufficiency, checked on 28/07/2022.

Purvis, Ben; Mao, Yong; Robinson, Darren (2019): Three pillars of sustainability: in search of conceptual origins. In *Sustain Sci* 14 (3), pp. 681–695. DOI: 10.1007/s11625-018-0627-5.

Raworth, Kate (2017): Doughnut economics. Seven ways to think like a 21st-century economist. London: Random House Business Books.

Rockström, J.; Steffen, W.; Noone, K.; Persson, Å.; Chapin, F. S., III; Lambin, E. et al. (2009): Planetary Boundaries: Exploring the Safe Operating Space for Humanity. In *Ecology and Society* (14(2): 32). Available online at http://www.ecologyandsociety.org/vol14/iss2/art32/, checked on 03/07/2021.

Steffen, Will; Richardson, Katherine; Rockström, Johan; Cornell, Sarah E.; Fetzer, Ingo; Bennett, Elena M. et al. (2015): Sustainability. Planetary boundaries: guiding human development on a changing planet. In *Science (New York, N.Y.)* 347 (6223), p. 1259855. DOI: 10.1126/science.1259855.

Strand, R.; Kovacic, Z.; Funtowicz, S.; Benini, L.; Jesus, A. (2021): Growth without economic growth. Edited by EEA. European Centre for Governance in Complexity; European Environmental Agency. Available online at https://www.eea.europa.eu/publications/growth-without-economic-growth, updated on 05/19/2021, checked on 06/04/2021.

Swilling, Mark (2020): The Age of Sustainability. Just Transitions in a Complex World. London, New York: Routledge Taylor & Francis Group (Routledge studies in sustainable development).

UNEP (2013): Metal recycling. Opportunities, limits, infrastructure: this is report 2b of the Global Metal Flows Working Group of the International Resource Panel of UNEP. With assistance of Markus Reuter, Christian Hudson, Antoinette van Schaik, Kari Heiskanen, Christina Meskers, Christian Hagelüken. Edited by International Resource Panel.

UNEP (2014): Decoupling 2. Technologies, Opportunities and Policy Options. With assistance of Ernst Ulrich von Weizsäcker, Jacqueline Aloisi de Larderel, Karlson Hargroves, Christian Hudson, Michael Harrison Smith, Maria Amelia Enriquez Rodrigues. Edited by International Resource Panel.

UNFCC (2015): The Paris Agreement. Available online at https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement, checked on 28/06/2022.

Wiedmann, Thomas; Lenzen, Manfred; Keyßer, Lorenz T.; Steinberger, Julia K. (2020): Scientists' warning on affluence. In *Nature communications* 11 (1), p. 3107. DOI: 10.1038/s41467-020-16941-y.

re-sourcing

Coordinated by:

Vienna University of Economics and Business,
Institute for Managing Sustainability,
Welthandelsplatz 1A

1020 Vienna

phone: +43-1-31336-5452